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(54) FIBER OPTIC GYROSCOPE

FASEROPTISCHER KREISEL

GYROSCOPE A FIBRE OPTIQUE

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Description

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The invention relates to a rotation sensor according to the preamble of claim 1, and to a method of forming a rotation sensor. Accordingly, the present invention relates generally to a slip interface between sensor coils for fiber optic gyroscopes and mounting hubs, and specifically to an arrangement for supporting a potted sensor coil that minimizes temperature-induced Shupe effect due to fiber stressing.

DESCRIPTION OF RELATED ART

[0002] A rotation sensor of the initially - mentioned type is known, e.g., from WO 0 040 928 A. An interferometric fiber optic gyroscope (IFOG) includes the main components of a light source, a beam splitter, a fiber optic sensing coil made of either polarization maintaining (PM) fiber or a low birefringence (standard telecommunications) fiber, a polarizer (sometimes more than one), and a detector for light from a light source which is split by loop beam splitter into counter-propagating waves traveling in the sensing coil. The associated electronics measure the phase relationship between the two interfering counter-propagating beams of light that emerge from opposite ends of the coil. The difference between the phase shifts experienced by the two beams is proportional to the rate of rotation of the platform to which the instrument is fixed, due to the well known Sagnac effect.

[0003] Environmental factors can affect the measured phase shift difference between the counter-propagating beams, thereby introducing an error, such environmental factors include variables, such as temperature, vibration and magnetic fields. In general, such factors are unevenly distributed throughout the coil. These environmental factors induce variations in the optical light path that each counter-propagating wave encounters as it travels through the coil. The phase shifts induced upon the two waves are unequal, producing an undesirable phase shift which is indistinguishable from the rotation-induced signal.

[0004] Past approaches to reducing some of the sensitivities arising from environmental factors, have involved the use of a potting compound to pot the windings of the sensor coil within a matrix of an adhesive material. Such an approach is described in U.S. Patent No. 5,321,593 for "Sensor Coil for Low Bias Fiber Optic Gyroscope", assigned to the assignee of the present application, and U.S. Patent No. 5,546,482 for "Potted Fiber Optic Gyro Sensor Coil for Stringent Vibration and Thermal Environments", also assigned to the assignee of the present invention. Careful selection of the potting material (particularly in terms of elasticity) results in reduction of vibration-induced bias, coil cracking, degradation of h-parameter and temperature-ramp bias sensitivity. In these arrangements, the coil is formed on a spool of carbon composite material whose coefficient of expansion approximates that of the overlying fiber windings. By closely matching the thermal expansion characteristics of the spool and the fiber windings as well as properly selecting the coil potting material, the Shupe-like bias caused by thermal stress that would be otherwise exerted by a standard metallic spool is minimized.

[0005] While the use of adequate potting and spool materials will tend to minimize bias environmental sensitivities, conventional support and spool designs, which feature a substantially-cylindrical hub sandwiched between a pair of end flanges, are difficult to "match" to the potted coil. This is due to the asymmetry of expansions of such coils in response to temperature change. The coefficients of thermal expansion of a potted coil in the axial direction is often on the order of one-hundred (100) times that of the radial direction. Unfortunately, a corresponding asymmetry does not exist with regard to the supporting spool. Rather, spools of conventional design and material composition exhibit isotropic thermal expansion characteristics. This relative imbalance introduces bias errors through coil stressing and creates bonding and cracking problems with the potting material in the potted coil. For example, in a spool-and-coil arrangement in which the material of the hub of the spool closely approximates the radial coefficient of the thermal expansion of the potted coil, the axial expansion of the coil will exceed that of the hub. As a result, significant axial compression of the coil can occur when the temperature rises since axial expansion of the potted coil is limited by a relatively "fixed' separation distance between the spool's end flanges. Further, the stressing due to differential thermal expansion coefficients at the coil-hub interface can result in either rupture or in coil cracking. On the other hand, in a spool fabricated of material closely matching the axial coefficient of thermal expansion of the potted coil, one may expect the relatively-greater radial expansion of the hub in response to temperature change to degrade performance by squeezing the fiber of the coil whose radial dimension is relatively fixed.

[0006] In order to address the thermally induced Shupe bias that results from the aforementioned thermal incompatibility of conventional spool designs with the asymmetric radial and axial thermal expansion coefficients of potted sensor coils, there have been attempts at designing spools with a single mounting flange and an interior hub. In these arrangements, the coil is mounted on the hub with its central axis traverse to the plane of the flange so that the coil is free to expand axially without the constraint of a second flange on the opposite side of the potted coil from the single mounting flange. For instance, U.S. Patent No. 5,545,892 of Bilinski et al., entitled "Gyro Sensor Coil with Low-Friction Hub Interface", also assigned to the assignee of the present invention, discloses a single mounting flange and central hub assembly having the central hub coated with a non-adhesive material.

The non-adhesive coating provides a relatively friction-free surface upon which the innermost layer of the potted coil is free to slide to accommodate its significant axial expansion when subject to heating.

[0007] Although this approach of using a non-adhesive coating on the central hub allows the potted coil to expand axially in response to temperature changes, the potted coil is not mechanically connected to the central hub and can become physically separated from the surface of the non-adhesive coating when the potted coil experiences thermal expansion or compression due to certain temperature changes. This mechanical separation causes the potted coil to become thermally disconnected from the central hub, which can result in sudden changes in the Shupe-driven bias behavior of the IFOG. Further, the separation of the potted coil from the central hub subjects it to vibration-induced bias effects that result from the free-standing arrangement of the potted coil relative to the spool. Such bias effects can become particularly acute in an environment that includes vibrations at the resonant frequency of the potted coil. Moreover, the operative mechanism of such device for overcoming the effects of axial coil expansion relies upon the ability of the potted coil to slide freely upon the surface of the hub. Even slight imperfections in the coating on the hub can on occasion cause a deleterious so-called "stick and slip" phenomenon. This effect can cause irregular and quasi-periodic stressing of the coil fiber resulting in unpredictable bias errors in the gyro output.

SUMMARY OF THE INVENTION

[0008] The foregoing shortcomings and disadvantages of the prior art are alleviated by the present invention that provides a rotation sensor for use in a fiber optic gyroscope including the features of claim 1. The slip interface allows the potted coil to expand or contract along the axial direction of the central hub due to thermal expansion while maintaining a constant thermal and mechanical connection between the interface and the potted coil. In this manner, the present invention, maintains the integrity of the connection of the potted coil to the slip interface during thermal expansion of the potted coil, thus minimizing temperature-induced Shupe bias errors in the rotation sensor. Further, the invention provides a method of forming a rotation sensor according to claim 11. Further embodiments of the invention are described in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The features of the present invention, which are believed to be novel, are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further advantages, may best be understood by reference to the following description, taken in connection with the accompanying drawings in which the reference numerals, designate like parts throughout the figures thereof and wherein:

FIG. 1 is a perspective view of an embodiment of a rotation sensor formed not in accordance with the present invention;

FIG. 2 is a cross-sectional view of the rotation sensor of FIG. 1 taken generally along lines 2-2;

FIG. 3 is a fragmentary, cross-sectional view of another embodiment of a rotation sensor not formed in accordance with the present invention;

FIG. 4 is a fragmentary, cross-sectional view of yet another embodiment of a rotation sensor not formed in accordance with the present invention;

FIG. 5 is a perspective view of a partially-constructed rotation sensor in accordance with an embodiment of the present invention formed using a cylindrical shim; and

FIG. 6 is a fragmentary, cross-sectional view of the rotation sensor of FIG. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] The following description is provided to enable any person skilled in the art to make and use the invention and sets forth the best modes contemplated by the inventors of carrying out their invention. Various modifications, however, will remain readily apparent to those skilled in the art, since the general principle of the present invention have been defined herein specifically to provide a system and method for providing an improved IFOG hub to coil thermal and mechanical slip interface.

[0011] FIG. 1 is perspective view of a rotation sensor 10 for a fiber optic gyroscope not formed in accordance with the present invention having a sensor coil 12 comprising a plurality of turns of an optical fiber 14 engaged to a spool 16 of the type wherein the central axis of the coil (as indicated by dashed line 17) is orthogonal to the plane of a singe mounting flange 18. The spool 16 includes a central cylindrical hub 20 having the mounting flange 18 extend radially from one ends. The sensor 10 is formed by winding the continuous optical fiber 14 in a predetermined configuration around the central hub 20. During the winding process or thereafter the coil 12 is impregnated with a potting material, wherein this potting material further serves to bond the coil 12 to the mounting flange 18. Alternatively, a separate layer of adhesive material may be used to adhere the potted coil 12 to the mounting flange 18.

[0012] In order to overcome the effects of Shupe bias errors associated with prior rotation sensors when the potted coil would become separated from the central hub during thermal expansion, the rotation sensor 10 includes a slip interface 22 positioned between the potted coil 12 and the central hub 20, as shown in FIG. 2. The innermost layer 24 of the potted coil 12 is wound upon and in contact with the slip interface 22. In contrast to free-standing coil arrangements, the potted coil 12 is not free-standing as it is radially supported by the central hub 20 of the spool 16 through its connection to the slip interface 22. As a result, the potted coil 12 does not in and of itself constitute an independent structure subject to vibrations near or at its resonant frequency. Rather, it is secured to the spool 16 both through intimate contact to the slip interface 22 and further by being affixed to the mounting flange 18 to form a combined composite structure whose resonant frequency is much high than that of a free-standing potted coil.

[0013] The slip interface 22 minimizes Shupe bias errors by allowing thermal expansion of the potted coil 12 along the axial direction of the central hub 20 while maintaining a constant thermal and mechanical connection with the potted coil 12. The slip interface 22 preferably comprises a helically-wound spring having an inner diameter slightly larger the outer diameter of the central hub 20 so that there is a minimal gap between the slip interface 22 and the hub 20. The slip interface 22 will be described hereinafter as comprising a helically-wound spring, but the slip interface 22 may also comprise a plurality of individual hoops or rings positioned in a spaced-apart relationship along the central hub 20 or may comprise other similar structures having a plurality of portions spaced-apart from one another along the axial direction of the central hub 20.

[0014] The central hub 20 is preferably formed of a material having low thermal expansion characteristics, such as titanium, an appropriate carbon composite, or other low-thermal expansion materials. The slip interface 22 is formed of a material having substantially the same thermal expansion characteristics as the central hub 20 in order to minimize thermal stresses between the slip interface 22 and the central hub 20. The slip interface 22 has a resting length L_1 extending along an axial direction of the outer diameter of the central hub 20, wherein the length L_1 of the slip interface 22 is less than the axial length L_2 of the central hub 20 in order to allow the slip interface 22 to expand along the axial direction of the central hub 20. The helical winds of the slip interface 22 are separated by spaces 26 in the axial direction of the central hub 20 to further allow the slip interface 22 to contract along the central hub 20. In the helically-wound spring configuration of the slip interface 22, the spaces 26 may exist in the resting length L_1 of spring slip interface 22 or the slip interface 22 can be stretched to provide these spaces 26 between the spaced-apart portions of the slip interface 22. This stretching of the slip interface 22 would further cause the inner diameter of the spring slip interface 22 to tighten over the outer diameter of the central hub 20 to further resist radial vibrations, where the amount of stretching can be chosen based on the desired radial vibration performance.

[0015] As previously described, the potted coil 12 will experience volumetric expansion and contraction as it undergoes temperature cycling, where this results in a disparity between axial and radial thermal expansions. By forming the potted coil 12 over a slip interface 22 having the ability to expand and contract, the structure of the slip interface 22 provides a surface which may expand and contract in the axial direction in conjunction with the thermal expansion of the potted coil 12. The unified movement of the slip interface 22 and the potted coil 12 due to the thermal expansion of the potted coil 12 in the axial direction prevents thermal stresses from developing between the slip interface 22 and the potted coil 12. This reduction of thermal stresses prevents cracks from forming in the potting material in the potted coil 12 and maintains the integrity of the mechanical bond between the potted coil 12 and the slip interface 22, thus minimizing the Shupe bias errors which would result from cracks developing in the potting material in the potted coil 12 and from the potted coil 12 becoming mechanically and thermally separated from the central hub 20 during thermal expansion. The rotation sensor 10 provides a slip interface 22 between the central hub 20 and the potted coil 12 which increases the resonant vibration frequency of the coil structure well beyond the range of vibration inputs without sacrificing the ability to absorb vastly different degrees of thermal expansion in the radial and axial directions.

[0016] In another rotation sensor as shown in FIG. 3, a base layer of potting material 30 is formed over the slip interface 22 prior to the winding the potted coil 12. The base layer 30 provides a smoother and more pliant surface on which the potted coil 12 can be wound in order to prevent the optical fiber in the first layer 24 of the potted coil from becoming compressed or squeezed during the winding process. Thus, the base layer 30 further assists in reducing fiber stressing in the potted coil 12. The base layer 30 preferably comprises the same potting material used in the potted coil 12 or may include other materials substantially matching the thermal expansion characteristics of the potting material used in the potted coil 12 so as to minimize thermal stresses between the two potting materials. The base layer 30 extends in the spaces 26 between the spaced-apart portions of the slip interface 22 and allows the slip interface 22 to contract along the axial direction of the central hub 20.

[0017] In each of the rotation sensors mentioned, the particular size, shape, and configuration of the slip interface 22 can be chosen depending upon a variety of design considerations, including the desired thermal expansion characteristics of the slip interface 22, the potted coil 12, the base layer 30, and the central hub 20. Other factors which may also be taken into consideration when selecting the configuration of the slip interface 22 include but are not limited to the desired heat transfer from the central hub 20, the amount of friction between the central hub 20 and the slip interface 22 from movement of the slip interface 22 during thermal expansion of the potted coil 12, and the particular winding of the potted coil 12. The particular cross-sectional shape of the helical winding or rings of the slip interface 22 can be variably chosen based upon the above-listed design considerations. For instance, the slip interface 22 can have a rectangular cross-sectional shape in order to provide a smooth, flat surface for winding the potted coil 12 thereupon, as illustrated in FIG. 4. Furthermore, the number of windings in the interface 22 and the length of the spacing 26 between the spaced-apart portions of the slip interface 22 can also be selected depending upon the particular thermal expansion characteristics of the potted coil 12 and base layer 30.

[0018] Referring now to FIG. 5, a rotation sensor 52 of the present invention is illustrated where a cylindrical shim 50 is positioned in the gap between the central hub 20 and the slip interface 22 in order to retain the slip interface 22 in its desired position while the rotation sensor 52 is formed. The inner diameter of the slip interface 22 is slightly larger than the outer diameter of the central hub 20 in order to allow the slip interface 22 to be positioned around the central hub 20. It is also desirable to leave a small gap between the central hub 20 and slip interface 22 in order to allow the slip interface 22 to compress when experiencing certain temperature changes. The shim 50 is utilized to occupy this gap between the outer diameter of the central hub 20 and the inner diameter of the slip interface 22, wherein the shim 50 frictionally engages the inner surface of the slip interface 22 in order to retain it its desired position during the formation process. After the base layer 30 is formed over the slip interface 22, the potted coil 12 is wound, and all the potting materials are cured, the components of the rotation sensor 10 are set in their desired positions and the shim 50 is then removed. The shim 50 should be formed of a metallic material or other similar material having sufficient stiffness to frictionally engage and retain the slip interface 22 in its desired position. The shim 50 is described as being cylindrical, but it is understood that the shim 50 may comprise any cross-sectional that occupies the space between the central hub 20 and the interface 22.

[0019] Once the shim 50 is removed, a gap 52 will be exist in the area the shim occupied between the slip interface 22 and the central hub 20, as shown in FIG. 6. Radial centering of the potted coil 12 with respect to the central hub 20 will be provided by the attachment of the potted coil 12 to the mounting flange 18 via the cured potting material. In order to resist translational vibration of the coil pack 12 and slip interface 22 structure at the opposite end of the spool from the mounting flange 18, at least one tack of adhesive material 54 may be positioned in the gap 52 at the opposite end of said mounting flange 18. A plurality of equally circumferentially-spaced adhesive tacks 54 are preferably positioned around the central hub 20 in the gap 52 in order to minimize vibrational movement of the coil pack 12. It is also possible to position a continuous layer of adhesive material or a resilient O-ring in the gap 52 at the opposite end of the spool from the mounting flange 18 after the shim 50 is removed. The adhesive tacks 54 should be formed from an adhesive material having sufficient stiffness to resist translational vibration while allowing the slip interface 22 to move axially with the thermal expansion of the potted coil 12.

[0020] As can be seen from the foregoing, the improved IFOG hub to coil slip interface of the present invention provides a thermally conductive layer that the potted coil is wound upon which maintains a constant thermal and mechanical contact with the potted coil during thermal expansion of the potted coil. Moreover, a rotation sensor formed with the IFOG hub to coil slip interface of the present invention is substantially free of bias errors due to the changing temperatures and vibration present in the surrounding environment. Furthermore, a rotation sensor for an IFOG formed in accordance with the present invention reduces coil stressing and prevents bonding failure and cracking from occurring in the potting material within the potted coil.

[0021] Those skilled in the art will appreciate that various adaptations and modifications of the just-described preferred embodiment can be configured without departing from the scopeof the invention. Therefore, it is to be understood that, within the scope of the appended claims, the invention may be practiced other than as specifically described herein.

Claims

1. A rotation sensor for use in a fiber optic gyroscopic having a spool (16) with a substantially cylindrical central hub (20) and a substantially planar mounting flange (18) at one end thereof, with a coil (12) having a plurality of layers of coaxial turns of optical fiber embedded in a potting material, having an inner surface surrounding the central hub (20) and having an end affixed to a surface of the mounting flange (18), with an interface (22) positioned between an outer surface of the central hub (20) and the inner surface of the coil (12), the improvement therein **characterized by:**

   the interface having a length along the axial direction (17) of the central hub (20) from the mounting flange (18) which changes in conjunction with the thermal expansion of the coil (12) with the inner diameter of the interface being slightly larger than the outer diameter of the central hub (20) leaving a gap between the central hub (20) and the interface (22), and an adhesive material (54) positioned at least at one point, between the outer surface of the central hub (20) and the inner surface of the interface (22).

2. The rotation sensor of claim 1, wherein the interface (22) allows the coil (12) to expand or contract along the axial direction of the central hub (20) while maintaining constant contact with the inner surface of the coil (12).

3. The rotation sensor of claims 2, wherein the interface (22) includes a plurality of portions which are spaced-apart from one another along the axial direction of the central hub.

4. The rotation sensor of claim 1, wherein the interface (22) is formed from a material having substantially the same thermal expansion characteristics as the central hub (20).

5. The rotation sensor of claim 1 further comprising a layer of second potting material (30) positioned over the interface (22).

6. The rotation sensor of claim 5, wherein the potting material (30) has substantially the same thermal expansion characteristics as the material in the coil (12).

7. The rotation sensor of claim 3, further comprising a layer of second potting material (30) positioned over the interface (22), wherein the layer of second potting material (30) extends in the areas between the spaced-apart portions of the interface (22).

8. The rotation sensor of claim 1, wherein the length of the interface (22) is less than the axial length of the central hub (20).

9. The rotation sensor of claim 1, wherein the adhesive material (54) is positioned at equally circumferentially-spaced points around the central hub (20) at an opposite end of said central hub (20) from the mounting flange (18), in order to minimize vibrational forces acting on the interface.

10. The rotation sensor of Claim 3 wherein the interface is a helically wound spring.

11. A method of forming a rotation sensor of the type that includes a coil (12) having an inner surface and formed of a plurality of layers of turns of optical fiber encapsulated in a potting material and wound about the outer surface of a central hub (20) of a spool (16) of the type that includes at least one mounting flange (18), comprising
positioning an interface (22) over an outer surface of said central hub (20), wherein said interface (22) has a length along an axial direction of said central hub (20) which changes in conjunction with the thermal expansion of said potted coil (12);
positioning a cylindrical shim (50) around said central hub which extends between said central hub (20) and said interface (22) in older to control the position of said interface (22) on said central hub;
forming said potted coil (12) over said interface (22) by winding the plurality of turns of optical fiber around said interface (22) and encapsulating the turns of optical fiber in a potting material, said potting material further affixing said potted coil (12) to said mounting flange (18); and
removing said cylindrical shim (50) after said potted coil is formed over said interface.

12. The method of claim 11; further comprising the step of placing an adhesive (54) between said central hub (20) and at least one point on an inner surface of said interface (22) in a spacing left between said central hub (20) and said interface by the removal of said cylindrical shim (50).

13. The method of claim 12 wherein said adhesive (54) is positioned at equally circumferentially-spaced points ground said central hub (20) on an opposite end of said central hub from said mounting flange (18) in order to minimize vibrational forces acting on said interface.

Patentansprüche

1. Rotationssensor zur Verwendung in einem faseroptischen Gyroskop, der eine Spule (16) aufweist mit einer im Wesentlichen zylinderförmigen zentralen Nabe (20) und einem im Wesentlichen ebenen Befestigungsflansch (18) an einem Ende davon, mit einer Wicklung (12), die aufweist: eine Mehrzahl von Schichten koaxialer Umdrehungen von Lichtleitfasern, die in ein Vergussmaterial eingebettet sind, eine Innenfläche, die die zentrale Nabe (20) umgibt, und ein Ende, das an einer Oberfläche des Befestigungsflansches (18) befestigt ist, wobei eine Schnittstelle (22) zwischen einer Außenfläche der zentralen Nabe (20) und der Innenfläche der Wicklung (12) positioniert ist, wobei die Verbesserung daran **dadurch gekennzeichnet ist, dass**:

die Schnittstelle eine Länge entlang der axialen Richtung (17) der zentralen Nabe (20) von dem Befestigungsflansch (18) aus aufweist, die sich in Verbindung mit der Wärmeausdehnung der Wicklung (12) ändert, wobei der Innendurchmesser der Schnittstelle etwas größer als der Außendurchmesser der zentralen Nabe (20) ist, wodurch eine Lücke zwischen der zentralen Nabe (20) und der Schnittstelle (22) bleibt, und wobei ein Haftmaterial (54) zumindest an einem Punkt zwischen der Außenfläche der zentralen Nabe (20) und der Innenfläche der Schnittstelle (22) positioniert ist.

2. Rotationssensor gemäß Anspruch 1, wobei die Schnittstelle (22) ermöglicht, dass sich die Wicklung (12) entlang der axialen Richtung der zentralen Nabe (20) ausdehnt oder zusammenzieht, wobei der Kontakt mit der Innenfläche der Wicklung (12) konstant

aufrechterhalten wird.

3. Rotationssensor gemäß Anspruch 2, wobei die Schnittstelle (22) eine Mehrzahl von Abschnitten aufweist, die entlang der axialen Richtung der zentralen Nabe im Abstand voneinander angeordnet sind.

4. Rotationssensor gemäß Anspruch 1, wobei die Schnittstelle aus einem Material gebildet ist, das im Wesentlichen dieselben Wärmeausdehnungs-Eigenschaften wie die zentrale Nabe (20) aufweist.

5. Rotationssensor gemäß Anspruch 1, ferner eine Schicht aus zweitem Vergussmaterial (30) aufweisend, die über der Schnittstelle (22) positioniert ist.

6. Rotationssensor gemäß Anspruch 5, wobei das Vergussmaterial (30) im Wesentlichen dieselben Wärmeausdehnungs-Eigenschaften wie das Material in der Wicklung (12) aufweist.

7. Rotationssensor gemäß Anspruch 3, ferner eine Schicht aus einem zweiten Vergussmaterial (30) aufweisend, die über der Schnittstelle (22) positioniert ist, wobei die Schicht des zweiten Vergussmaterials (30) sich in die Bereiche zwischen den im Abstand voneinander angeordneten Abschnitten der Schnittstelle (22) erstreckt.

8. Rotationssensor gemäß Anspruch 1, wobei die Länge der Schnittstelle (22) kleiner als die axiale Länge der zentralen Nabe (20) ist.

9. Rotationssensor gemäß Anspruch 1, wobei das Haftmaterial (54) an in Umfangsrichtung im gleichen Abstand um die zentrale Nabe (20) angeordneten Punkten an einem zu dem Befestigungsflansch (18) entgegengesetzten Ende der zentralen Nabe (20) positioniert ist, um die Schwingkräfte, die auf die Schnittstelle wirken, zu minimieren.

10. Rotationssensor gemäß Anspruch 3, wobei die Schnittstelle eine schraubenlinienförmig gewickelte Feder ist.

11. Verfahren zum Ausbilden eines Rotationssensors der Art, die eine Wicklung (12) aufweist, die eine Innenfläche aufweist und aus einer Mehrzahl von Schichten von Umdrehungen von Lichtleitfasern gebildet ist, die in einem Vergussmaterial eingekapselt sind und um die Außenfläche der zentralen Nabe (20) einer Spule (16) der Art gewickelt sind, die mindestens einen Befestigungsflansch (18) aufweist, wobei das Verfahren aufweist:

Positionieren einer Schnittstelle (22) über einer Außenfläche der zentralen Nabe (20), wobei die Schnittstelle (22) eine Länge entlang einer axialen Richtung der zentralen Nabe (20) aufweist, die sich in Verbindung mit der Wärmeausdehnung der vergossenen Wicklung (12) ändert,
Positionieren einer zylinderförmigen Abstandsscheibe (50) um die zentrale Nabe, die sich zwischen der zentralen Nabe (20) und der Schnittstelle (22) erstreckt, um die Position der Schnittstelle (22) auf der zentralen Nabe zu steuern,
Ausbilden der vergossenen Wicklung (12) über der Schnittstelle (22) durch Aufwickeln der Mehrzahl von Umdrehungen von Lichtleitfasern um die Schnittstelle (22) und durch Einkapseln der Umdrehungen von Lichtleitfasern in einem Vergussmaterial, wobei das Vergussmaterial die vergossene Wicklung (12) weiter an dem Befestigungsflansch (18) befestigt, und
Entfernen der zylinderförmigen Abstandsscheibe (50), nachdem die vergossene Wicklung über der Schnittstelle gebildet ist.

12. Verfahren gemäß Anspruch 11, ferner aufweisend den Schritt des Platzierens eines Haftmittels (54) zwischen der zentralen Nabe (20) und mindestens einem Punkt an einer Innenfläche der Schnittstelle (22) in einem Abstandsraum, der zwischen der zentralen Nabe (20) und der Schnittstelle durch das Entfernen der zylinderförmigen Abstandsscheibe (50) zurückgelassen wird.

13. Verfahren gemäß Anspruch 12, wobei das Haftmittel (54) an in Umfangsrichtung im gleichen Abstand angeordneten Punkten um die zentrale Nabe (20) an einem zu dem Befestigungsflansch (18) entgegengesetzten Ende der zentralen Nabe positioniert ist, um die Schwingkräfte, die auf die Schnittstelle wirken, zu minimieren.

Revendications

1. Capteur de rotation destiné à être utilisé dans un gyroscope à fibre optique ayant un dévidoir (16) avec un moyeu central (20) sensiblement cylindrique et un rebord de montage (18) sensiblement plan au niveau de son extrémité, avec une bobine (12) ayant une pluralité de couches de spires coaxiales de fibre optique noyées dans un matériau d'imprégnation, ayant une surface interne entourant le moyeu central (20) et ayant une extrémité fixée sur une surface du rebord de montage (18), avec une interface (22) positionnée entre une surface externe du moyeu central (20) et la surface interne de la bobine (12), l'amélioration étant **caractérisé par** :

l'interface ayant une longueur le long de la direction axiale (17) du moyeu central (20) à partir du rebord de montage (18) qui change conjointement à la dilatation thermique de la bobine (12) avec le diamètre interne de l'interface qui est légèrement plus grand que le diamètre externe du moyeu central (20), laissant un espace entre le moyeu central (20) et l'interface (22) et un matériau adhésif (54) positionné au moins au niveau d'un point, entre la surface externe du moyeu central (20) et la surface interne de l'interface (22).

2. Capteur de rotation selon la revendication 1, dans lequel l'interface (22) permet à la bobine (12) de se dilater ou de se contracter le long de la direction axiale du moyeu central (20) tout en maintenant un contact constant avec la surface interne de la bobine (12).

3. Capteur de rotation selon la revendication 2, dans lequel l'interface (22) comprend une pluralité de parties qui sont espacées les unes des autres le long de la direction axiale du moyeu central.

4. Capteur de rotation selon la revendication 1, dans lequel l'interface (22) est formée à partir d'un matériau ayant sensiblement les mêmes caractéristiques de dilatation thermique que le moyeu central (20).

5. Capteur de rotation selon la revendication 1, comprenant en outre une couche de second matériau d'imprégnation (30) positionnée sur l'interface (22).

6. Capteur de rotation selon la revendication 5, dans lequel le matériau d'imprégnation (30) a sensiblement les mêmes caractéristiques de dilatation thermique que le matériau dans la bobine (12).

7. Capteur de rotation selon la revendication 3, comprenant en outre une couche de second matériau d'imprégnation (30) positionnée sur l'interface (22), dans lequel la couche de second matériau d'imprégnation (30) s'étend dans les zones situées entre les parties espacées de l'interface (22).

8. Capteur de rotation selon la revendication 1, dans lequel la longueur de l'interface (22) est inférieure à la longueur axiale du moyeu central (20).

9. Capteur de rotation selon la revendication 1, dans lequel le matériau adhésif (54) est positionné au niveau de points espacés circonférentiellement à égale distance autour du moyeu central (20) au niveau d'une extrémité opposée dudit moyeu central (20) du rebord de montage (18) afin de minimiser les forces de vibration qui agissent sur l'interface.

10. Capteur de rotation selon la revendication 3, dans lequel l'interface est un ressort enroulé de manière hélicoïdale.

11. Procédé pour former un capteur de rotation du type qui comprend une bobine (12) ayant une surface interne et formé avec une pluralité de couches de spires de fibre optique encapsulées dans un matériau d'imprégnation et enroulées autour de la surface externe d'un moyeu central (20) d'un dévidoir (16) du type qui comprend au moins un rebord de montage (18), comprenant les étapes consistant à :

positionner une interface (22) sur une surface externe dudit moyeu central (20), dans lequel ladite interface (22) a une longueur le long d'une direction axiale dudit moyeu central (20) qui change conjointement à la dilatation thermique de ladite bobine (12) imprégnée ;
positionner une cale cylindrique (50) autour dudit moyeu central qui s'étend entre ledit moyeu central (20) et ladite interface (22) afin de contrôler la position de ladite interface (22) sur ledit moyeu central ;
former ladite bobine (12) imprégnée sur ladite interface (22) en enroulant la pluralité de spires de fibre optique autour de ladite interface (22) et en encapsulant les spires de fibre optique dans un matériau d'imprégnation, ledit matériau d'imprégnation fixant en outre ladite bobine (12) imprégnée sur ledit rebord de montage (18) ; et
retirer ladite cale cylindrique (50) après que ladite bobine imprégnée a été formée sur ladite interface.

12. Procédé selon la revendication 11, comprenant en outre l'étape consistant à placer un adhésif (54) entre ledit moyeu central (20) et au moins un point sur une surface interne de ladite interface (22) dans un espace laissé entre ledit moyeu central (20) et ladite interface par le retrait de ladite cale cylindrique (50).

13. Procédé selon la revendication 12, dans lequel ledit adhésif (54) est positionné au niveau de points espacés circonférentiellement à égale distance autour dudit moyeu central (20) sur une extrémité opposée dudit moyeu central dudit rebord de montage (18) afin de minimiser les forces de vibration qui agissent sur ladite interface.

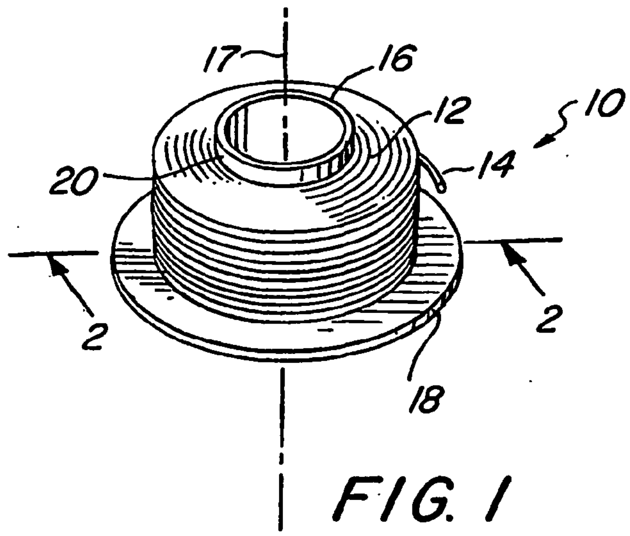

FIG. 1

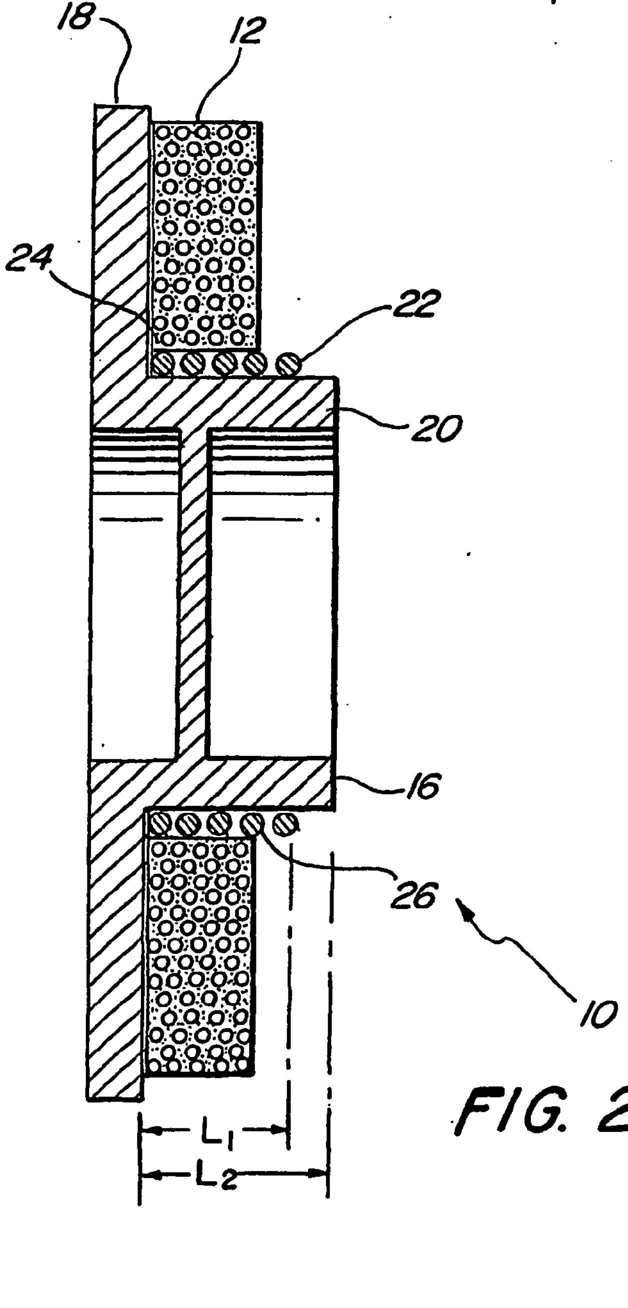

FIG. 2

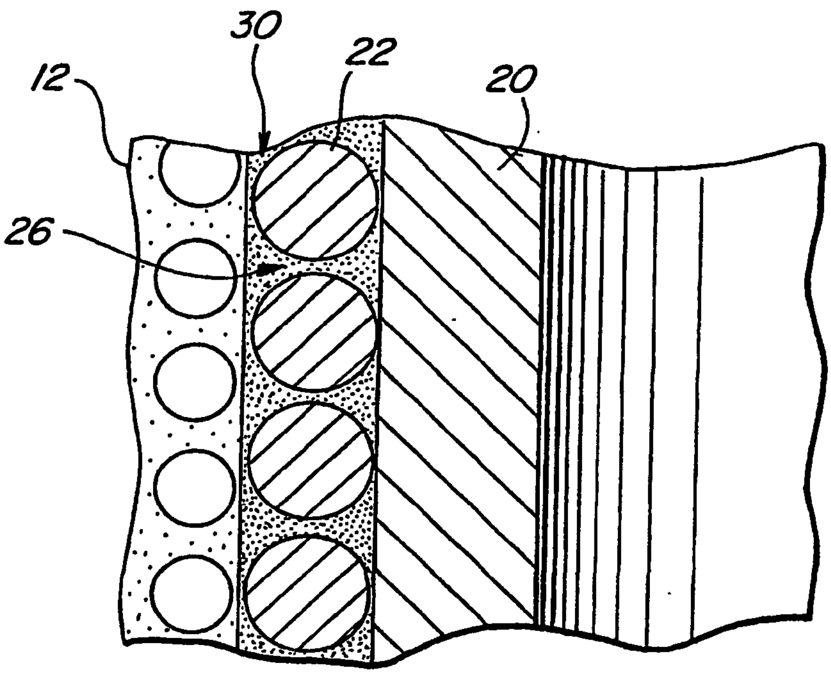

FIG. 3

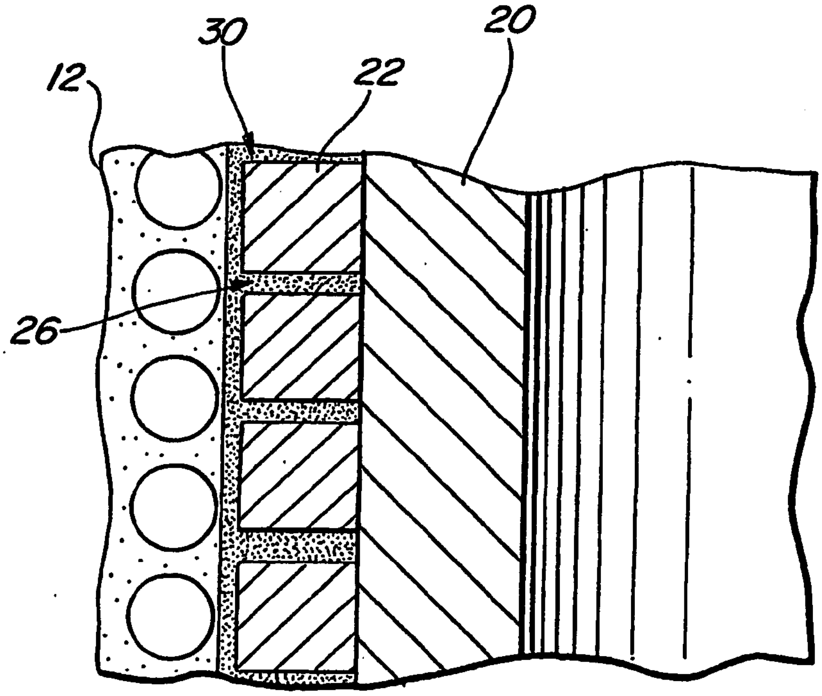

FIG. 4

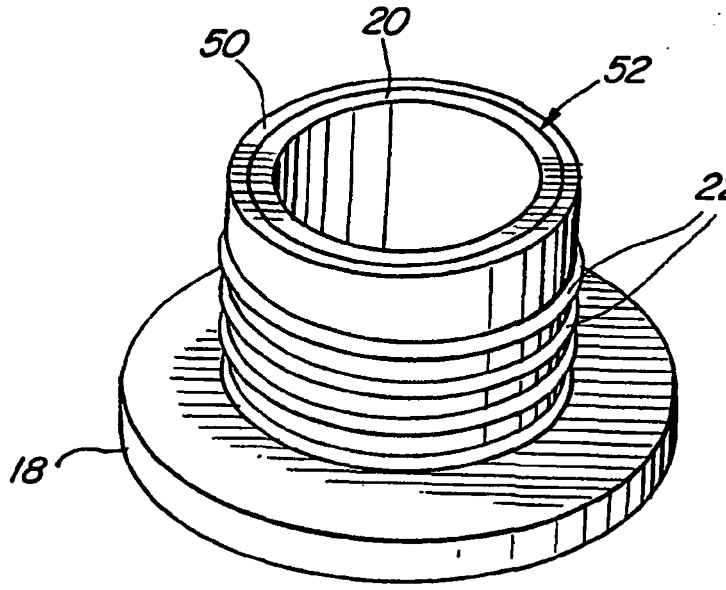

FIG. 5

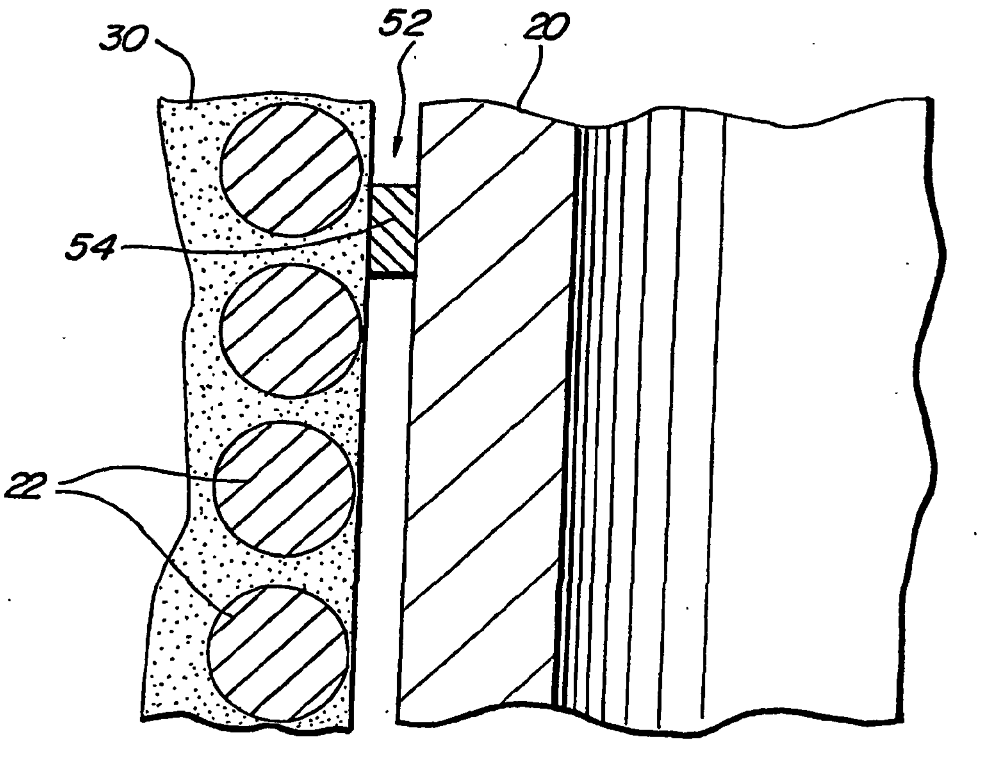

FIG. 6

REFERENCES CITED IN THE DESCRIPTION

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